ACCURATE AUTOMATION CORPORATION

7001 Shallowford Road
Chattanooga, Tennessee 37421
(615) 894-4646 • FAX (615) 894-4645

STTR PHI Contract No. N00014-94-C-0156

SIGNAL PROCESSING CHIPS/ELECTRONICS

9 November 1994

Technical Report #1
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Contractor's Technical Report (U) Unclassified

Report Number: AAC-94-053
CLIN Number: 0001AA

Prepared for:
Dr. Joel L. Davis
Office of Naval Research
800 North Quincy Street
CODE: 342
Arlington, VA 22217-5000
Telephone Number: (703)696-1212

ACCURATE AUTOMATION CORPORATION

Robert M. Pap

Robert M. Pap
President

RMP:srt
attachment: October Technical Report

cc: ACO
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DTIC ✓

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November 9, 1994

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RE: Technical Report for Contract No. N00014-94-C-0156
Signal Processing Chips/Electronics, CLIN 0001AA

Accomplishments to date.
During the first five weeks of this contract, we have done the following:

- Refined the system design as originally presented in the Phase I proposal. Our refined design will be useful for combining reports from any two position determining sensors (e.g. radar, IFF, and/or other), as well as combining reported detections with position. The design combines information from two sources; it can be cascaded to provide information based on more than two sensors.

- We considered potential options for hardware implementation which would be done in Phase II and beyond. We identified several portions of the design suitable for embedding in unique electrical circuits. However, this would be costly. *We have identified that the full biologically-based sensor fusion system (Bio-SF System) can be implemented in the Accurate Automation Corporation Neural Network Processor (NNP).* The current NNP will be sufficient to illustrate the concept. The next-generation NNP, with 128K neurons, will be available during Phase II of this work. By using several of these to map out the full space covered by sensors, we anticipate being able to demonstrate a neural-based hardware realization of the Bio-SF System under conditions of high target density with noise and clutter at the end of Phase II.

- We continued to identify the *Navy relevance* of the *biologically-inspired approach to sensor fusion* drawing on our recent experience of being on board a U.S. Naval carrier vessel. We believe that the technology embedded in the Bio-SF System will be useful for:

  - *Improved target detection* with higher probability of detection and lower false alarm rates, especially under noisy conditions, *useful in CATCC, Detection and Tracking*, and other areas,

- *Improved tracking of highly maneuvering targets, especially useful in Detection and Tracking systems* (part of the Combat Direction Center),
- *Improved target localization* when multiple target reports (both own platform and other platform) provide conflicting target positions,
- *Mechanism for determining and correcting platform offset biases* when dealing with sensor information provided by multiple platforms, *useful in the Combat Direction Center and in Flag Operations,* and
- *Mechanism for alerting and increasing sensitivity to target detection* as cued by contexts useful in CDC.

We believe that the Bio-SF System will be most useful as a display system, operating on inputs from two sensors, and providing fused target information directly to the user. This system design should be useful in CATCC, CDC, and Flag Operations.

- We determined that the best implementation of this system would be to use object-oriented design methods which can be applied to Ada systems design. When Ada 9X, an object-oriented Ada, becomes available, the object-oriented design will be translated readily into that environment (Phase II). This will in no way impede successful implementation in hardware such as the NNP.

- We had several in-depth conversations with Dr. Barry Stein, our Research Institution Investigator on this project. The conversations dealt with design issues, and in identifying what was known about how the brain handled issues which are of concern in system design, such as:

  - Does the brain, particularly the superior colliculus, have a tracking mechanism to predict where an object will be? (Dr. Stein says not in the superior colliculus, although the ability of all higher invertebrates to track and predict the location of objects suggests that such a mechanism must exist).

  - What is the ability of a detected target to inhibit activations in neighboring areas, yielding improved position localization? (Dr. Stein says a salient stimulus can inhibit neighboring neurons, thus dampening sensitivity towards other detections).

  - Does the receptive field for a stimulated neuron change with the variance in target position from predicted? This would help to automatically set receptive field size appropriately. (Dr. Stein says receptive field size changes with *alertness* which is another parameter altogether. However, this can be brought into our design at a later state.)

- Dr. Maren and Dr. Stein participated in an ONR-sponsored workshop on Sensory/Sensor Fusion at Woods Hole, MA. Dr. Maren described how biological sensor fusion concepts aided design of Navy-relevant sensor fusion systems. Dr. Stein described some principles of biological sensor fusion.

	Budgeted Amount	Cummulative Amount	Remaining Amount
Labor	8,779.80	1,491.47	7,288.33
Overhead	11,018.65	1,871.79	9,146.86
Travel	3,599.00	0.00	3,599.00
Subcontractor (Wake Forest)	40,000.00	0.00	40,000.00
ODC	2,200.00	1,780.00	420.00
G&A	26,238.98	2,057.31	24,181.67
Profit	7,347.00	568.85	6,778.15
	99,183.43	7,769.42	91,414.01
Man Hours	378	37	341

ODC's	DTIC	Books/Journal	Material/Softw	Travel
October 1994	0.00	721.00	1,059.00	

Sincerely,

Alianna J. Maren

Alianna J. Maren, Ph.D.
Principal Investigator

AJM:srt